OSWER Docket
EPA Docket Center
Environmental Protection Agency
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1200 Pennsylvania Ave., NW
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RE: Attention Docket ID No. RCRA-2003-0012.

These comments are being offered jointly by the three pilot schools (Boston College, the University of Massachusetts Boston and the University of Vermont) involved in the New England University Laboratories Project XL.

We chose to become involved in this significant effort because we share the Agency's goal of improving our chemical waste management programs to better protect human health and the environment through procedures that are harmonious with the way laboratories operate in a college/university setting. At the same time, we are committed to preventing pollution by conserving resources in the lab. We believe that these goals are compatible and, indeed, one is not possible without the other.

We are concerned that the current application of RCRA regulations to laboratory settings does not encourage either hazardous waste minimization or resource conservation. This is because RCRA's prescriptive approach focuses entirely on waste handling procedures rather than including larger considerations involved in laboratory chemical management.

Based on our work in the XL project, we believe that careful laboratory housekeeping and process redesign provide greater pollution prevention opportunities than strict adherence to the RCRA waste management system. Therefore, we offer the following thoughts based on our experience with our Environmental Management System (EMS) based programs for management of chemical laboratory waste, as enabled by the regulatory flexibility granted under the XL program.

Background Lessons

Our experience with implementing an Environmental Management Plan (EMP) as required by the XL regulation has been well documented, both in our annual reports (see http://www.c2e2.org) and in peer reviewed publications, primarily *Chemical Health and Safety* published by the American Chemical Society. We are providing a copy of the article *"Piloting an EMS-based regulation for chemical waste in laboratories: A Lab XL progress report"* which was published in the May/June 2003 edition of CHAS as part of this file. Our comments in this letter will focus on the management "lessons learned" from this work that are directly applicable to regulatory rulemaking. We do not provide specific recommendations for regulatory changes that might be derived from these lessons; such recommendations are being provided by other comments, specifically those endorsed by the Campus Consortium for Environmental Excellence, which we are members of.

Management Flexibility

We believe that our most important lesson is that implementing an effective management plan in a complex, decentralized organization (which describes nearly every laboratory organization) requires time, creativity, and flexibility. Several iterations of the development process are required to optimize implementation of the plan within a particular organization's culture. This optimization process is necessary in order for the program to be effective and efficient and, thus, sustainable. In our case, the process for each school to implement an EMP has taken four years; we expect to continue to see significant improvement in the laboratories' performance for at least three more years before the maximum benefit (e.g., changes in the laboratory practices to realize of pollution opportunities) of this approach is achieved.

Based on this experience, we believe that, given enough time and flexibility, an effective hazardous waste minimization program will reduce the toxicity and amount of chemical wastes generated by laboratory activities. However, such a system of continuous improvement of pollution prevention practices requires that regulatory inspectors assess a program's compliance status by assessing whether the overall system maintains hazardous waste management practices compliant with RCRA based upon an institutional plan, rather than by detecting violations on a laboratory by laboratory basis as is currently done in some jurisdictions.

Performance Orientation

Another regulatory lesson we have learned from our XL experience is the importance of minimizing the number of regulatory requirements that an organization has to respond to. In our case, the XL regulation required the development of a 17-point Environmental Management Plan, conformance with a set of 16 Minimum Performance Criteria, meeting 8 "organizational responsibilities" and tracking 9 environmental performance indicators. Because we were involved in extensive discussions about the content of the final regulation, we understand how these various elements fit together to meet the needs of the regulators and campuses to assure an effective program. As the programs were implemented on each campus however, managing all these requirements simultaneously made the process more complex, and thus much slower, than we had anticipated.

We believe that one of the key values of our XL pilot was to identify the critical elements of an effective program that other aspects could be built around. We urge the Agency to simplify its approach to this issue by taking a "performance orientation" to the development of a new rule. We believe a performance-oriented approach will help ensure compliance, support an emerging culture of pollution prevention and attract the greatest number of institutions to participate in this new regulatory program.

Key Elements of an Effective Program

With these considerations in mind, we would like to identify what we believe to be the three essential components of an effective laboratory waste management program which meets the goals of RCRA:

1) An effective training program. In addition to providing instruction to laboratory workers, training interactions provide an important feedback loop so that the training content and methods can be adjusted over time to meet the needs of the laboratory audience;
2) An efficient waste management and collection service. Policies and procedures specific to an institution's activities and resources must be implemented to assure that waste is stored in a way that minimizes risk, is removed from laboratories in a timely way, and the proper disposal method for the waste is chosen; and
3) An ongoing laboratory audit program that includes regular self-inspections and periodic reviews by EH&S or some other entity. These reviews assess laboratory conformance with campus container management and housekeeping requirements and waste minimization program expectations and include a feedback loop that assures that identified problems are effectively dealt with.

In addition, we believe that a complete program will include a **fourth element**, a laboratory waste minimization program. This program will include an ongoing dialogue with laboratory chemical users about how their work impacts hazardous waste disposal and provides an ongoing opportunity for minimizing that impact. While our XL work has demonstrated that identifying and evaluating specific waste minimization gains as they occur is challenging, a difficult path, we believe that it should be one of the key pillars of the waste management plan. This allows waste minimization to become an important aspect of laboratory work. We have found in the XL project that the importance of waste minimization is obscured when it is one of 17 elements in the Environmental Management Plan.

We believe that a program based on these four elements can and should be documented in an institutional waste management plan that will provide both internal auditors and external reviewers (including regulatory inspectors) the ability to assess the effectiveness of the program at complying with RCRA to assure the proper disposal of chemical wastes. These four elements correspond to the 4 steps in the "plan, do, check, act" model on which Environmental Management Systems are based, and thus provide the basis for a complete program. Thus, the simplification of the institutional plan requirements into these elements will provide adequate flexibility to allow laboratory institutions to realize significant environmental performance improvement without interfering with ongoing work in the laboratories. This emphasis on a partnership between the laboratories and the waste management program, rather than the imposition of additional regulatory requirements, is critical to obtaining the buy-in of laboratories to pursue any pollution prevention goals beyond compliance.

Minimum Performance Criteria

As mentioned above, the XL rule includes a large number of Minimum Performance Criteria meant to mirror RCRA requirements for waste management in Satellite Accumulation Areas. Based on our three years of laboratory audits and inspections, we believe that this list can be significantly distilled or subsumed within the elements of the EMP. The goals of RCRA can be met with three generic requirements for laboratory management of waste, which can be detailed in the institutional waste management program:

1) prevention of cross media transfer of waste;
2) adequate label information so that (a) trained personnel, designated by the institution, are able to make a RCRA waste determination and (b) laboratory workers or other visitors to the lab have basic information necessary to identify a chemical or its hazards; and
3) emergency preparedness measures appropriate to the risks of the laboratory.

We note that specific requirements that address all three of these issues are contained in the Chemical Hygiene Plan required by OSHA of most employers, and/or fire codes established and enforced by local fire departments or other Authorities Having Jurisdiction.

Conclusion

We expect to continue to work with the EPA's Regulatory Reinvention offices and the Office of Solid Waste to further develop the ideas described above. The purpose of today's letter is to highlight the most important lessons we have learned from the NE Lab XL that apply to the questions listed in the Federal Register Notice. Below you will find specific responses to these questions.

Please let us know if any of these points need clarification.

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In response to your EPA's specific questions:

Hazardous Waste Determination: Currently, you must make a hazardous waste determination at the ``point of generation'' of a waste.

1. When should the hazardous waste determination be made in a laboratory setting?

Hazardous waste determination is a regulatory, rather than scientific, process and should be made by people with that specific expertise. In most cases, this will not be the laboratory scientist, but rather another campus employee or contractor who has received specialized training in the regulatory requirements associated with hazardous waste determinations. Because each campus may vary in the specific procedures for making a hazardous waste determination, this point of determination should be documented in a hazardous waste management plan. The requirements of the plan should be the standard against which regulators evaluate campus compliance with RCRA. We note that this is not a novel concept. For example, environmental regulators currently evaluate regulatory compliance based on an organization's plan for contingency planning, SPCC and other regulations.

2. What training is needed for lab personnel concerning hazardous waste determinations (e.g., full RCRA training or training that is made specific to chemical management duties)?

In cases where laboratory scientists are given this responsibility, full RCRA training is appropriate. However, if non-laboratory people are making the hazardous waste determination, training for lab personnel should be adequate to assure that 1) they reliably provide adequate information about the wastes to the person making the determination and 2) prevent improper disposal of wastes that they manage.

3. How should waste be labeled so it can be appropriately managed as hazardous waste (e.g., the words ``hazardous waste'' or a detailed chemical description)?

The requirements for labeling chemical wastes should be specified by the institutional waste management plan. Such labeling should be adequate for both employee and emergency responder safety, as specified in OSHA and fire code requirements. For example, OSHA requires full identification of the chemicals in the container and hazard warnings appropriate to those chemicals. Fire code requirements vary, but in general focus on NFPA diamonds or similar systems for identifying the general hazard associated with a chemical work area rather than on specific chemical containers.

4. Where should the hazardous waste determination be made (e.g., on the bench or in the 90 to 180 day storage area)?

This will depend on the expertise and resources available in the laboratory and waste management office so will vary from institution to institution. Therefore, it should be specified in the institutional waste management plan.

Satellite Accumulation Area (SAA) Accumulation Time: If more than 55 gallons of hazardous waste or more than 1 quart of acute hazardous waste is accumulated at a SAA, the excess must be removed within three days.

1. How should these requirements be applied in a laboratory context?

Specific requirements for waste container management, based on quantities and frequencies of generation, risks, and characteristics of storage locations in the laboratory should be specified in the institutional waste management plan.

2. How often do laboratories accumulate more than 55 gallons of waste in their SAA?

Our experience is that this is an unusual situation, primarily because laboratory space is too valuable to be used for the storage of waste materials. One important note here is that application of SAA thresholds vary from state to state. In Massachusetts for example, a satellite accumulation area (e.g., a laboratory) may only collect wastes in one container regardless of the size. So even if the container is 1 gallon once the container is full, it must be removed before another container can be started. In this case, the three day rule begins even if volumes are much less than 55 gallons.

3. What, if any, difficulties do environmental health and safety personnel have responding to waste pick-up calls, e.g., within the three day time limit?

Institutions manage waste pick-ups through a variety of measures. Some or all of the work may be outsourced, and waste pick-up frequencies will vary with the amount of waste produced by the lab. Schedules vary from institution to institution, but seldom do universities have the support staff or contractor resources to ensure three days is a reasonable turn around time for removal of wastes from a laboratory. Accumulation requirements should be based on the storage capacity of the laboratory spaces and specified in the institutional waste management plan.

4. How would a longer time-frame for removal impact the cost of waste management and the ability to protect human health and the environment?

A longer time frame for removal of wastes from the laboratory will allow the waste program to be efficient in planning and accomplishing waste pick ups. Because the quantities of waste accumulating are generally one gallon or less and storage hazard limits are established by fire codes, longer accumulation times should not present new hazards to either workers or the environment.

Sincerely,

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Piloting an EMS-based regulation for chemical waste in laboratories: A Lab XL progress report

By Thomas Balf, Francis Churchill, Gail Hall, Zehra Schneider Graham, and Ralph Stuart

As the 21st century opens, the traditional approach to environmental regulation has begun to show significant limitations. While the regulations promulgated under the Clean Air Act, Clean Water Act and RCRA have been successful at addressing many historical environmental problems by establishing engineering solutions aimed at reducing pollution emitted to various environmental media, these same regulations and their interpretations by regulators have limited the interest of companies in going beyond compliance to achieve effective pollution prevention programs. This is because establishing a compliant environmental program can be so expensive that it often makes financial sense to use it as much as possible, even when environmentally preferable alternatives, such as source reduction of waste, may be available.

Recognition of this problem has increased regulatory interest in the idea of implementing Environmental Management Systems (EMSs) as a holistic approach to managing an organization's environmental impacts. EMSs seek to identify all significant environmental impacts and institutionalize goals within the organization to continuously minimize those impacts. However, one of the challenges for those seeking to implement EMSs is the regulatory framework currently in place that emphasizes current compliance over continuous improvement.

This paper reports on our work in the Lab-XL project (see below for a description of this effort) in adapting the concepts behind the EMS approach to a long-standing regulatory compliance problem: regulation of chemical waste in laboratories. This regulatory issue arises because the nature of laboratory use of chemicals is fundamentally different from chemical use in industry and these differences have led to enforcement actions at a variety of institutions based on procedural concerns rather than physical pollution. Both Congress and EPA have expressed interest in moving forward to clarify this issue. This interest has been sparked by three recent studies: (1) release of a Mid-Term Evaluation of the Lab-XL project by EPA, (2) completion of the Howard Hughes Medical Institute's Collaborative Hazardous Waste Management Demonstration Project (see http://www.epa.gov/epaoswer/osw/specials/labwaste/), and (3) development of a regulatory reform proposal on the issue by the Higher Education Initiative.

These various activities set the stage for a new understanding of how RCRA should apply in a laboratory setting in order to best meet the goals of proper chemical waste disposal and pollution prevention. In order for this new understanding to develop into a workable alternative for laboratory institutions, it is important that a wide range of stakeholders become and stay informed and involved in the ongoing discussions. We believe that our early results help inform this discussion by demonstrating the potential value of an EMS approach to this issue.

PROJECT BACKGROUND

Since 1980, when the RCRA hazardous waste regulations were promulgated, there has been continuing controversy about how best to interpret these regulations in laboratory settings. Laboratory institutions generate hazardous wastes in significantly different ways than the centralized industrial processes on which RCRA is modeled. Ambiguity around concepts such as "process," "inherently waste-like" and "waste determination" creates confusion about when RCRA

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requirements should apply to specific chemical containers. Highlighting this confusion are the significantly different enforcement results following laboratory inspections in various EPA Regions and states (see From the Masthead, *Chem. Health Safe.* **2002**, *9*, 36–37).

The controversy intensified in 1999 and 2000, when the three northeastern EPA Regional Offices (Regions 1, 2 and 3) announced enforcement initiatives aimed at the higher education sector, which includes many laboratory-intensive institutions. Historically, the ambiguities mentioned above had forced colleges and universities to manage their laboratory chemical hazardous waste based on historical interpretations and extrapolations of the RCRA regulations. In several cases, EPA regional offices disagreed with the way these regulatory interpretations were implemented, leading to enforcement actions and six-figure fines for the inspected institutions.

In response to this problem, three pilot schools (Boston College, the University of Massachusetts Boston, and the University of Vermont) signed a Project XL agreement in 1999 with EPA New England and the states of Massachusetts and Vermont to test a performance-based regulation for chemical wastes from laboratories. The details of the conceptual basis for this "Lab-XL" project have been previously described in this journal (*Chem. Health Safe.* **2000**, *7*, 32–40). "Performance-based" means that the regulation focuses on whether the institutional waste management program attains specific environmental goals, rather than on requir-ing specific procedures (for example, with regard to labeling practices and accumulation times) as RCRA does.

The approach the pilot schools took in developing this regulation was to apply the principles of Environmental Management Systems to the issue at hand. This approach envisions the issue from a systems perspective by identifying opportunities for monitoring the performance of the system as a whole, including feedback loops that reinforce the way the system operates. The EPA was particularly interested in this approach because, while EMSs are increasingly popular internationally, there is little documentation of the net effects on environmental performance following the implementation of an EMS at U.S.-based institutions.

Thus, after active negotiations between the schools and the EPA, a two-pronged approach was developed in the final regulation. Development of an Environmental Management Plan (EMP) specific to each institution was required, which included selecting performance targets and objectives that tracked environmental performance. This is the EMS aspect of the project. Then, in order to satisfy the regulatory need for assessing compliance with the regulation, specific procedure-based, auditable "Minimum Performance Criteria" were included. Thus the resulting regulation was a hybrid between the approach OSHA took in developing the Chemical Hygiene Plan (a management system approach) and the more traditional RCRA requirements.

THE EMS BASIS OF THE LAB-XL PROJECT

The Lab-XL project assesses whether the regulatory flexibility granted by the performance-based alternative rule proposed by the pilot schools leads to superior environmental performance at the three schools. The Environmental Performance Indicators (EPIs) chosen to measure this change focused on three areas:

- workers' awareness of potential environmental issues associated with laboratory work;
- laboratory compliance with the institution-specific Environmental Management Plan; and
- pollution prevention and laboratory hazardous waste minimization at the institutional level.

These areas correspond to the working hypothesis of the project: that specific activities by health and safety workers and laboratory management would lead to *culture changes* within the institutions (measured by worker awareness levels). These culture changes would result in *behavior changes* in the laboratories (measured by the compliance indicators), which would then result in *physical improvements* in terms of preventing pollution associated with laboratory work. Thus, the cultural changes are a leading indicator of the desired change, while the physical changes are the lagging indicator (see Figure 1). This hypothesis is based on adapting the principles of Environmental Management Systems to the issue of laboratory chemical wastes.

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INSTITUTIONAL ASPECTS OF THE LAB-XL PROJECT

While the three pilot schools appear to be reasonably similar in terms of the number of students (see Table 1), it is clear that there are significant differences between them. There is great variability in both the number of laboratories and the types of programs offered. This situation makes this project a good example of why it is so difficult to find a "one size fits all" approach to environmental management in higher education.

In order to provide context for the EPI results, a short description of each school in terms of its hazardous waste generation is appropriate.

Boston College's College of Arts and Sciences includes teaching and active laboratory research in a number of areas: Biology, Chemistry, Geology and Geophysics, Physics and Psychology. The Chemistry Department is the home of an active organic chemistry

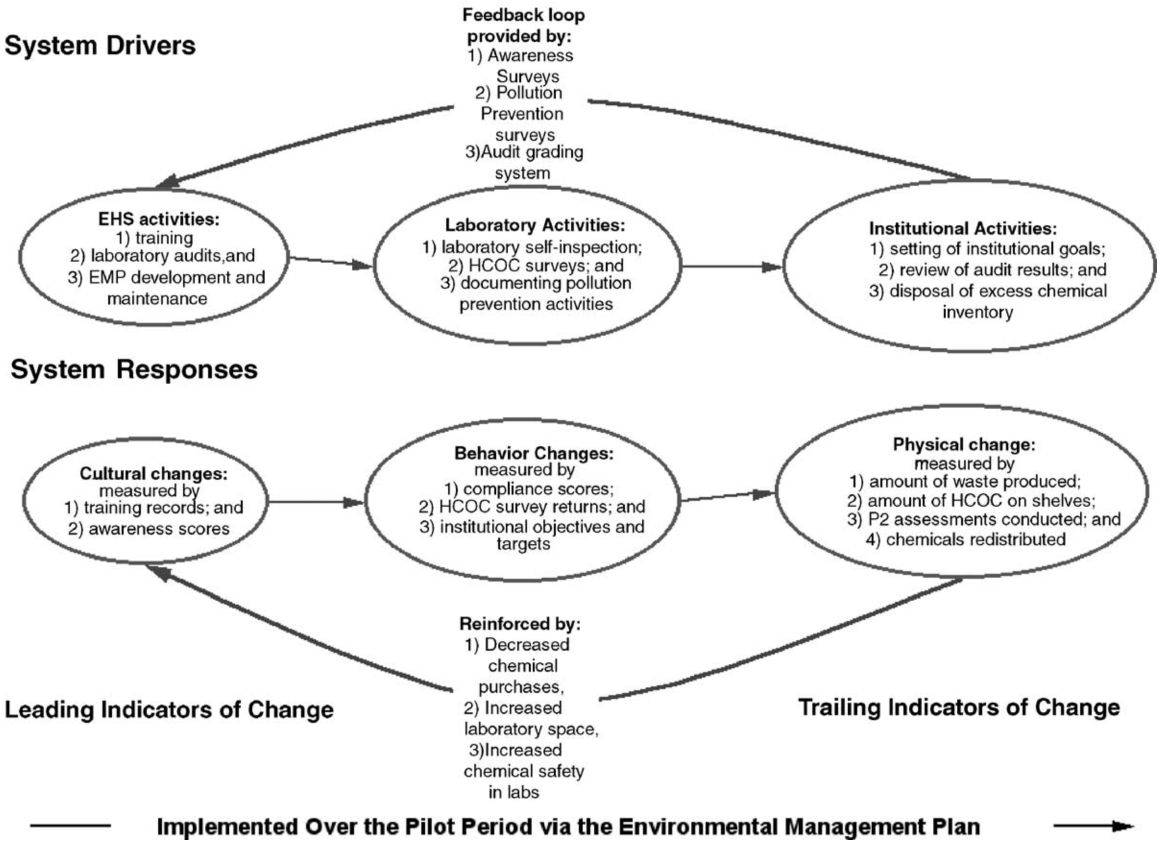

Figure 1. Lab XL system model.

group which is the source of 80% of the university's waste in the form of bulk solvents.

Laboratories at the University of Massachusetts Boston are spread more evenly across a variety of traditional science departments, such as chemistry, biology and environmental sciences. None of these programs are of the size of Boston College's Chemistry Department in terms of hazardous waste production. In fact, UMB would be a small quantity generator except for the amount of EPA-designated "acutely hazardous" waste it produces.

In addition to the traditional arts and science departments, the University of Vermont includes a College of Medicine, which accounts for more than half of its laboratories and a

Table 1. Participating XL Institutions

Institution	Approximate student population	Approximate number of labs	Programs affected by the XL regulation
Boston College	14,000	130	Chemistry, Biology, Geology, Physics and Psychology
University of Massachusetts Boston	13,000	140	Chemistry, Biology, Psychology, Anthropology, Geology and Earth Sciences, and Environmental, Coastal and Ocean Sciences
University of Vermont	10,000	525	Colleges of: • Agriculture and Life Sciences; • Arts and Sciences; • Medicine; • and Engineering and Mathematics; and Schools of: • Nursing; • Allied Heath Sciences; and • Natural Resources.

similar proportion of its chemical wastes. The chemical waste streams from the medical college, however, are generally simpler than those associated with (for example) the Chemistry Department, because biomedical research uses a relatively limited range of chemicals. UVM also includes agricultural and engineering colleges, which produce chemical wastes that are more varied than that of the rest of the university.

Because of these differences in the institutions' laboratory activities the Environmental Management Plans written to comply with specifications of the XL rule (40 CFR 262 subpart J) were significantly different at each of the three schools. These differences reflected the institutions' specific needs and existing programs. Staff at Boston College wrote an Environmental Management Plan that serves as a stand-alone guide to the management of chemical waste at the institution, while taking advantage of established lab safety programs from the Chemical Hygiene Plan. The University of Massachusetts Boston integrated its EMP into its existing Chemical Hygiene Plan, producing a single document. UVM took the approach of developing a linked series of procedures and forms (which overlapped with the Chemical Hygiene Plan) in order to cover the variety of chemical management issues at the institution. A lab that does not need a particular procedure does not need to be familiar with all of the plan's requirements.

THE EPIS: LAB-XL RESULTS TO DATE

The EPA's Project XL program allows members of its regulated community to propose regulatory change that they believe will allow for better environmental performance. Performance improvement is measured by specific Environmental Performance Indicators established for the project. Three progress reports giving all of the numerical results of the EPIs are available on-line at http://www.c2e2.org. These reports include both the baseline pre-XL numbers, as well as the 2000 and 2001 results. As this Project has a four-year timetable, many of the EPI results are still incomplete. This section will give a brief overview of the more interesting trends in the results to date that support the EMS lessons we describe below.

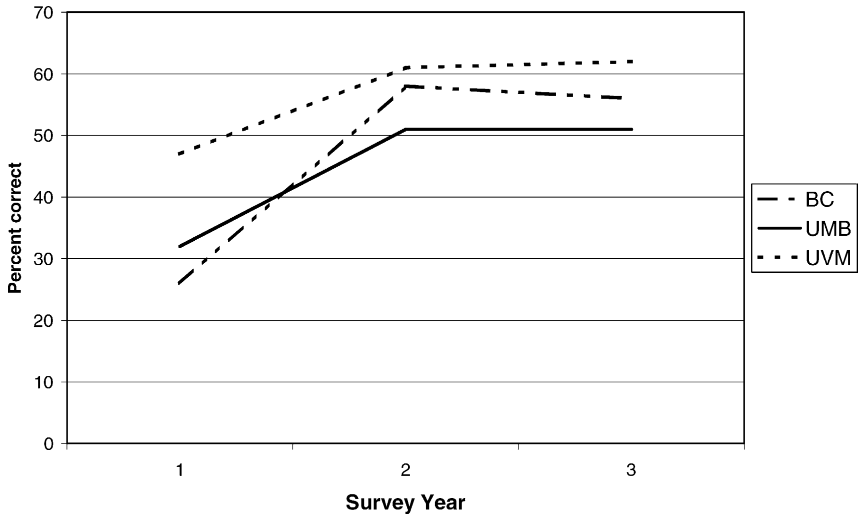

Figure 2. Environmental awareness scores.

Environmental Awareness and Training

In order to measure the cultural changes expected to occur as the Environmental Management Plan was implemented, the pilot schools developed an Environmental Awareness Survey to measure changes in lab workers' familiarity with the potential environmental impacts associated with laboratory work. It was expected that the results of later surveys would improve as the first phase of the EMP implementation, including increased training of workers, went forward.

The survey results confirmed this expectation (see Figure 2), although the magnitude of improvement in the second year was not similar to the large increase in awareness seen in the first year. The leveling-off of improvement demonstrates the on-going challenge associated with training a diverse laboratory population with significant turnover. All three schools significantly increased the amount of training they delivered as part of the EMP implementation process. The training increase resulted from increased departmental participation in the training efforts.

Chemical Waste Generation Rates

During the project negotiations, some people believed that the clearest pollution prevention benefit of the regulatory change would be a reduction in the amount of laboratory chemical waste generated. However, as Table 2 shows, the amount of this waste is highly variable and changes in ways that are not simple to explain. A variety of approaches to normalizing the data

Table 2. Laboratory Chemical Waste Generation (pounds)

	2001 (XL Year 2)	2000 (XL Year 1)	1999 (Baseline)	Change from 2000 to 2001	Baseline to 2001
Boston College	34,335	36,764	23,211	7% Reduction	48% Increase
University of Massachusetts Boston	5,584	3,710	5,584	50% Increase	No change
University of Vermont	33,387	38,269	38,646	13% Reduction	14% Reduction

Table 3. UVM Hazardous Chemicals of Concern Inventory Trends

Years	Number of individual HCOC per lab	Total pounds of HCOC per lab	Response rate (percent of laboratory supervisors responding)
Pre-EMP (1995–1999)	26	216	40
Post-EMP (2001–2002)	18	143	61
% Change	−34%	−34%	51

against available institutional data have been tried without decreasing the amount of variability seen.

Each school has had a different experience with this EPI over the period of the pilot project. For example, Boston College has seen a significant increase in the amount of lab waste generated because of a large increase in funded research in its organic chemistry program. The University of Massachusetts Boston saw its waste totals decrease 30% and then return to baseline levels. The primary reason for these changes was the start up of 15 new labs during this period, which impacted the 2001 results much more than the 2000. At UVM, the waste generation rates have shown a decrease over the last three years. This is probably because several laboratory clean-outs and renovations that occurred in 1999 and 2000 provided the opportunity to dispose of surplus chemicals as the implementation of the EMP proceeded. These results demonstrate the pitfalls of relying on a single indicator to judge the success of an EMS.

Hazardous Chemicals of Concern Trends

The concept of Hazardous Chemicals of Concern (HCOC) was developed as a risk-based approach to management of special chemical risks in an institution's labs. HCOC's were selected to focus attention on those materials that present special significance, both as safety hazards and as regulated wastes (peroxidizable compounds, poison inhalation hazards, "acutely hazardous" wastes, etc.). The EPIs were developed to measure the amount of "dusty, crusty" chemical containers (deemed by some to be "inherently wastelike") being stored in laboratories in order to see if the EMP approach could reduce their numbers.

Both Boston College and the University of Massachusetts Boston conduct complete chemical inventories as per local fire department requirements. At both schools, HCOC's have been identified as a subset of the complete inventories. Data from UVM, which has had the HCOC survey process in place for the longest period of time, indicates that the implementation of the Environmental Management Plan has both increased the participation of laboratories in the process and decreased the amount of HCOC's on the laboratory shelves (see Table 3).

Chemical Redistribution

One of the common concerns expressed about the traditional interpretation of RCRA was that requiring hazardous waste determinations to be done in the laboratories (a point that was commonly cited in enforcement actions) would restrict the potential for recycling of surplus chemicals within the institution. Thus, one of the EPIs was established to measure the potential increase in lab chemical recycling and reuse with this restriction removed.

As the EMPs were implemented, however, it became clear that the biggest barrier to reuse of surplus chemicals was not regulatory, but cultural. There has been significant resistance from laboratory workers to the idea of using chemicals that another lab has identified as waste (this concern is being explored as part of pollution prevention surveys being conducted at all three schools). Therefore, although waste chemicals are identified for reuse, there is little interest by laboratories in accepting surplus chemicals of unknown quality.

Lab Audits, Pollution Prevention, and Institutional Goals and Objectives

Some of the EPIs selected for the Lab-XL project have proven more problematic to implement than originally envisioned. These EPIs are those related to laboratory compliance audits, the pollution prevention assessments and the EMP goals and objectives. Work is continuing on these indicators, but specific approaches to these measurements are being rethought and alternatives developed as this is written. Therefore, any meaningful trends for these indicators are not yet evident.

EMS IMPLEMENTATION LESSONS LEARNED

An effort as ambitious as the Lab-XL project produces a variety of insights and lessons on many subjects. At this point, we are ready to identify several that relate both to the nature of the EMS-based rule and the implementation of the Environmental Management Plans. We believe that these lessons are important considerations as alternatives to RCRA are considered for application in the laboratory setting.

1. *Management flexibility is necessary to effectively implement a program designed to move beyond compliance in complex organizations.*

Implementation of a new environmental management system is a significant undertaking, with many implications for the entire organization undertaking the effort. Understanding these side effects can only be done in practice–by actually going through the process of implementing the system. This makes it difficult to predict ahead of time the environmental benefits and improvements that will result from an EMS. For this reason, we found that the structure of the Lab-XL project, which required us to try to measure many changes occurring simultaneously throughout the project, to be a particular challenge. This approach to evaluating the project created confusion in trying to track our progress. For example, two EPIs (4 and 5) seem to contradict each other–one aspires to recycle more waste, while the other aspires to produce less waste to recycle.

Based on our experience with the implementation of the EMP, we have decided to focus our efforts on specific categories of EPIs. Cultural change will be measured by increased emphasis on the awareness survey results, behavioral change by the audit scoring system and physical change by tracking the total amount of laboratory waste generated. Fortunately, within the context of a regulatory reinvention pilot project, such choices are possible–within the RCRA framework, prioritizing the changing elements within a continuous improvement system is not an option because all regulatory requirements are given equal priority.

2. *Implementation takes time and the appropriate indicators of progress change over the course of implementation.*

At each of the three schools, the process of developing the Environmental Management Plan provided the opportunity to respond more effectively to laboratories' needs for assistance in hazardous chemical management. Without exception, the schools have developed more systematic approaches to the overall management of hazardous chemicals as a direct result of the regulatory flexibility available under the rule.

However, successful implementation of the Environmental Management Program, has taken longer because the project required movement on several fronts simultaneously. We have had to balance work to be done in several directions in order to implement the project. These directions include development of clearer chains of responsibility for laboratory conformance, pursuit of a variety of pollution prevention strategies, and aggressive training and outreach efforts to the laboratory management and populations.

We have found that as this process proceeded, progress on some of the issues measured by the Environmental Performance Indicators has been significant, while performance for other EPIs has lagged. Based on this experience, we believe that it is important that indicators of progress be carefully selected to correspond to different stages of the program implementation and that the relative priority of the indicators be expected to change over the course of implementing an EMS.

3. *Objective audit criteria can provide valuable management information.*

One of the challenges of developing an Environmental Management System within the existing regulatory framework is that this framework includes specific criteria designed to help inspectors make objective decisions about whether a particular situation is in compliance with the regulation. Unfortunately, protecting these "enforcement hooks" often becomes the goal of a facility's environmental program rather than moving beyond mere compliance to meet the intent of the regulation.

In the Lab-XL project, the primary enforcement hooks are the Minimum Performance Criteria established by the standard to assure equivalence with RCRA requirements. However, they are included as specific requirements for the Environmental Management Plan. We have found these requirements for objective audit criteria to be as valuable for the program managers as they are for the inspectors.

For example, the EMP is required to include "procedures for the identification of environmental management plan noncompliance." This requirement helped the pilot schools to identify weaknesses in their existing management information systems (such as incomplete rosters of laboratory supervisors on campus) and helped prioritize which of these weaknesses were most urgent to address. This benefited not only the compliance status of the institutions, but also the management efficiency of the program, since the information developed to comply with the regulation was also critical in addressing upper management's questions about existing weaknesses in the waste management program.

The lesson we have learned from this observation is that choice of audit criteria is a careful balancing act: RCRA's enforcement hooks operate at a level of detail that is self-defeating in laboratories. Traditional academic criteria for identifying successful labs are too broad to be effective in meeting regulators' expectations. We believe that in the Lab-XL we have found a useful middle ground that is better able to support and evaluate efforts to protect human health and the environment.

4. *Feedback loops from the affected population are critical in maintaining the chain of cultural-behavioral-physical change.*

The EMS approach to environmental management relies on establishing a culture of environmental awareness among people whose work has potential environmental impacts. It is generally easy to identify ways that work should change to decrease environmental impacts. It is harder to identify ways to motivate people to change their work habits. One of the successes of the Lab XL project has been the establishment of feedback loops within the EMP which enable the program managers to understand what their ideas for changing chemical management processes would mean to the people doing laboratory work.

Information gathered during the training sessions, environmental awareness surveys and pollution prevention outreach efforts have enabled us to modify the chemical waste program as it is implemented to make it more effective in pursuing the overall goal of pollution prevention through hazardous waste minimization. The "willingness to listen" evidenced by these feedback loops has also increased our credibility in working with laboratory departments on environmental issues not related to hazardous waste disposal.

5. *It is important to work within the institutional culture and mission to implement an environmental management system effectively.*

Working within the institutional culture means that an environmental management program must support the institution's overall mission in order to win either upper management support or worker buy-in. In academia, this mission involves education, research and community service.

We have found that it is relatively easy to align an environmental management program with the overall academic mission, although the complexity of the academic organization requires that this be done in a flexible way. Health, safety and environmental protection are values that not in dispute, but variation in how they are pursued in different departments is critical for effective institution-wide implementation. The flexibility provided by the XL project has given us the ability to meet the significant challenges presented by the complex organizations involved in implementing an EMS.

For example educational institutions with a significant number of laboratories tend to have decentralized management structures. This means that laboratories may operate independently of each other and the school's central administration in order to retain the flexibility needed to meet an ever-changing research agenda. This management style creates a challenge in managing information about laboratory activities and staff that forms the foundation of an EMS.

On the other hand, there are also significant benefits for an environmental management program operating in an academic setting. A highly educated population means that when policies and procedures are unambiguous and well justified, changes towards compliance and generally agreed upon prudent practices are reasonably easy to achieve. Additionally, while the transient population found in higher education can make it difficult to deliver and document a specific training program, the interest of students and new workers can be a catalyst for the cultural change needed for EMS implementation.

Another advantage of the academic culture is that there are often obvious connections between the EMS and the institutional mission. For example, many academic institutions have environmental science and study programs that demonstrate a significant commitment to proper environmental management. The values represented by these academic programs can be leveraged to support good environmental management.

CONCLUSION

Past the halfway point of the Lab-XL project, we are still in the discovery mode. We have been able to ask interesting questions about the best ways to manage laboratory chemical waste to prevent pollution through waste minimization. At the same time, we are also collecting the data necessary to answer those questions. The final years of the project will tell us which trends will continue. But based on the first two years, we believe that the data shows that:

1. *Culture change is underway:* Environmental awareness has increased significantly over the course of the project. Environmental management training efforts have increased significantly and are reaching a larger portion of the laboratory population.
2. *Behavior change is following:* Laboratory conformance with the Environmental Management Plan is improving, but more slowly than cultural change.
3. *The big question is will physical changes follow?* The results to date demonstrated by the indicators chosen to measure the physical aspects of pollution prevention are more mixed and problematic for demonstrating future improvement. Even in the relatively fluid culture of higher education, sustained changes that will result in measurable changes in physical environmental performance will take several years to implement.